

Statement of Work Independent Assessments for Systems Analysis and Concepts Development

1. Purpose, Objective, and Background of Work:

The Systems Analysis and Concepts Directorate (SACD) is the NASA Langley Research Center organization that develops and delivers advanced concepts, systems analyses, and multidisciplinary methods in support of Agency Projects, Programs and Mission Directorates as well as for the NASA Chief Engineer and the Office of the Chief Technologist. In performing system analysis and design concepts SACD typically deploys the following disciplines:

- Vehicle / Configuration Design, Layout and Packaging
- Aerodynamics and Aerothermodynamics
- Thermal Analysis and Thermal Protection Systems
- Propulsion Systems
- Airframe and Engine Subsystems
- Trajectory / Flight Mechanics
- Vehicle Integration, Sizing and Closure
- Life Cycle Cost
- Reliability
- Operations
- Affordability
- Mission design and campaign analysis
- Technology assessment and prioritization

Support provided to SACD under this SOW includes, but is not limited to, the following activities:

1.1 Conceptual hypersonic and launch vehicle design, analysis, and optimization, technology assessment, and systems analysis related design environments and analytical tool development, verification and validation. This work requires a complete system conceptual design capability including all performance and life cycle related disciplines.

1.2 Provide support to Government personnel to assist with the definition and refinement of the U.S. National Space Policy, including leading the assessment and integration of a diverse set of exploration architecture design configurations to yield sustainable and affordable solutions for human and robotic campaigns in support of agency stakeholders. This activity includes, but is not limited to:

- The definition and assessment of exploration architecture requirements
- The integration of the human exploration campaign concept including mission design and campaign analysis
- The identification and prioritization of capability and technology needs

1.3 Provide element-level definition required for strategic campaign analysis, including defining and assessing the performance, cost, and risk characteristics of systems to support development and assessment activities for robotic systems, crewed and uncrewed systems, and surface systems.

1.4 Independent science mission analysis evaluating technical scope, trajectory analysis, orbital mechanics assessment, and feasibility of cost and schedule. This work includes, but is not limited to, independent assessment capabilities for space transportation, human and robotic architectures, campaign analysis and life cycle assessments. While NASA developed tools and methods may be used for analyses, the Contractor shall deploy independent tools and methods to provide objective cost, technical assessments, and other analyses.

2. Definitions:

- A “concept” is an idea or proposal for a subsystem, system, or architecture to be evaluated using system analysis tools and methodologies to determine the degree to which it satisfies goals and objectives.
- A “system” is an integrated set of concepts that can accomplish a defined objective.
- A “mission” refers to a single or multiple launches or flight(s) to accomplish a specific goal, which may be an end in itself or a constituent of a campaign.
- An “architecture” is a “system of systems”. It defines a set of functional capabilities, their translation into elements, their interrelations and operations. The architecture enables the implementation of various mission scenarios.
- A “campaign” is a series of coordinated missions that represent a unique strategy for satisfying a set of goals and objectives over a given timeframe. It can consist of one or more mission scenarios and employs all assets of the architecture.
- A “Portfolio Analysis” refers to decomposition from goals and objectives to project discipline research content for the purpose of prioritization, quantification of benefits, and performance of trade studies and gap analyses.
- A “Vehicle” refers to a launch system, hypersonic transport, spacecraft, or space transportation system.
- “Affordability” refers to architecture and system level affordability trade space exploration, optimization, and economic analysis; cost estimating is a subset of affordability.
- A “method” is an analytical approach or process for solving a problem.
- A “tool” is software that implements a method.
- A “technology trade” is a subset of a trade study where an infusion of different technologies is used to determine a delta (change) in performance/cost/risk/schedule.

3. Description of the Work to be Performed:

3.1 The Contractor shall perform vehicle conceptual design and analysis serving as an independent assessment capability or to support NASA design and analysis efforts. These activities include, but are not limited to:

- Estimation of vehicle performance and life cycle analyses including cost, reliability, operability of hypersonic and Earth to Orbit (ETO) launch vehicle designs and related systems, and trade studies on such designs producing deterministic and probabilistic results.
- Complete vehicle design and analysis to estimate standard ETO vehicle performance metrics, including but not limited to, mass, physical dimensions and mission performance.
- Cost analyses to estimate Design, Development, Test and Evaluation (DDT&E) and

- fleet production costs of the concept.
- Reliability analyses to determine probability of occurrence estimates for critical mission end-states such as Loss of Mission (LOM) and Loss of Vehicle (LOV).

3.2 The Contractor shall perform objective technology assessments to quantify the benefits of advanced technologies on vehicle performance and related Figures of Merit (FOMs). This effort includes, but is not limited to, collection and compilation of technology data, development of a baseline concept or system upon which technology trades will be made, identification of technology performance requirements, development of fast-acting surrogate models of vehicle discipline analyses to be used in probabilistic analyses; as well as the probabilistic analyses and quantification of technology impact to FOMs.

3.3 The Contractor shall perform campaign integration and integrated performance analyses of Human and Robotic missions and architectures. This shall include, but not be limited to, independent assessments of deployment concepts, surface element manifesting options (e.g. launch vehicle manifesting and lander packaging), and sustainability and resupply requirements, as well as updating current NASA provided and Contractor developed models as appropriate to support the analysis needs.

3.4 The Contractor shall develop concepts for human and robotic spacecraft systems and perform design concepts and associated analysis of spacecraft systems and subsystems. This work includes, but is not limited to; development of structural concepts, mass estimation, assessments of engineering structures and materials for element concepts and architectures to establish system requirements for these elements; definition of structural analysis requirements and capabilities for advanced systems analyses within the areas of modular systems and multi-functional structures; and feasibility of concepts to be manufactured, assembled, and integrated with Earth-to-orbit systems for future space exploration missions and architectures.

3.5 The Contractor shall perform conceptual trade studies for spacecraft subsystems including, but not limited to, communications, power, thermal, and propulsion subsystems for in-space, planetary descent, and planetary ascent trajectories. This activity includes, but is not limited to, the utilization of "stand alone" analytical tools and existing software applications to map resource utilization to mission phases, analytical support for life-cycle-cost (LCC) methods and costing of mission elements and architectures, affordability and affordability analysis, for future space exploration missions and other Science or Decadal Survey missions.

3.6 The Contractor shall develop and deliver analytical methods and tools as required to analyze, perform trade studies, archive, and visualize design concepts. The Contractor shall support the enhancement of existing analytical tools used to design and analyze concepts and related systems.

3.7 The Contractor shall provide independent assessment of existing analytical capabilities and tools, and identify improvements necessary to support system analysis and concept development.

3.8 In the performance of task orders, the contractor, its employees, and subcontractors shall execute non-disclosure agreements prior to reviewing proprietary or sensitive materials related to the work performed under this contract.

3.9 The contractor shall ensure all assessment and work products are objective, shall avoid personal and organizational conflicts of interest, and shall prevent unauthorized disclosure of proprietary and sensitive information as defined in contract Section I, NFS clause 1852.237-72, Access to Sensitive Information. The contractor shall avoid, mitigate, or neutralize Organizational Conflicts of Interests (OCI), personal conflicts of interest, and disclosure of sensitive or proprietary information in accordance with the contract terms.

4. Deliverables:

The contractor shall comply with all deliverable requirements in the contract and incorporated in individual task orders. The Government shall have unlimited and unrestricted rights to all deliverables; except as expressly agreed upon by the parties prior to task order award. Typical task order deliverables include, but are not limited to:

- Analysis results, including methodology, ground rules and assumptions
- Engineering reports, presentations, and white papers to document concept performance, operations, affordability, costing, capability/technology assessments, and technology investigations performed.
- Documentation of technology assessment approach and results
- Problem formulation briefings and reports
- Design and analysis process demonstrations
- Status reports to support face-to-face meetings.
- Tool development documentation including but not limited to method selection, programming methodology, dataset development, verification and validation.
- Users' guide(s)

5. Government Furnished Property and Information:

Government furnished property or information will be identified in individual task orders and may include, but not be limited to:

- Vehicle configuration details and campaign definition data to be used as inputs to the analyses.
- Access to NASA analytical tools
- Access to NASA data repository sites as applicable to complete task objectives.

6. Other information needed for performance of task:

6.1 Travel: Contractor travel shall be necessary to accomplish the requirements of this task including, but not limited to, multiple trips to numerous NASA Centers each year. Travel requirements will be defined in individual task orders.